

ART. IV.—*Studies on the Comparative Anatomy of the Alimentary Canal of Australian Reptiles.*

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AND

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(With Plate IV., and Text, Figs. 1-5.)

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**Introduction.**

For a correct understanding of the structure and function of the human body a knowledge of the anatomy and physiology of the reptile is essential, and its importance cannot be too strongly emphasised. Land animals, air breathers, provided in the cases of the monitors and lizards with arms and legs, they enable us to review ourselves from a more primitive standpoint. They represent a living embryology—an embryology in which you can not only study structure, but also function. Here we find respiration carried on without a diaphragm, a heart that has not yet evolved four chambers, undescended testes and a penile groove representing the genesis of a urethra, kidneys placed caudal to the testes and ovaries, a gastro-intestinal arrangement which makes simple the study of the seemingly complex human gastro-intestine, and a miniature spleen, compared with the size of the animal and in contrast to the relatively great spleen found in the lowest mammal—the platypus.

For reptilian study no country offers such a field as Australia; for here we have the large carpet, (non-poisonous) snake, the poisonous varieties such as the black, brown, and tiger, and numerous lizards such as the stump-tailed and blue tongued varieties, as well as the giant lizards or monitors. This work is based on investigations of the following reptiles:—

Carpet snake (non-poisonous) *Python spilotes*.

Brown snake (poisonous) *Diemenia textilis*.

Black snake (poisonous) *Pseudechis porphyriacus*.

Tiger snake (poisonous) *Notechis scutatus*.

Stump-tailed lizard (non-poisonous) *Trachysaurus rugosus*.

Blue-tongued or giant skink (non-poisonous) *Tiliqua scincoides*.

Cunningham's skink (non-poisonous) *Egernia cunninghami*.

Friiled lizard (non-poisonous) *Chlamydosaurus kingii*.

Bearded lizard (non-poisonous) *Amphibolurus barbatus*.

Monitors (non-poisonous) *Varanus varius* and *gouldii*.

## Alimentary Canal of Reptiles.

- a). Stump-tailed lizard (*Trachysaurus rugosus*)  
 Frilled lizard (*Chlamydosaurus kingii*)  
 Bearded lizard (*Amphibolurus barbatus*).  
 Giant skink (*Tiliqua scincoides*)  
 Cunningham's skink (*Egernia cunninghami*)

If the ventral wall of one of the above be removed, extending from the mouth in front to the cloacal aperture caudally, we expose a cavity containing not only the stomach, liver, intestines, and the genito-urinary system; but the trachea, heart, and lungs as well. We are immediately struck not only by the absence of a diaphragm defining an abdominal from a thoracic cavity, but also by the relatively large liver provided, as in us, with a gall bladder. Beginning from the oral extremity and proceeding caudally we note the following structures:—floor of the mouth and pharynx, trachea crossed by a well defined thyroid gland, heart and great vessels behind which lies the bifurcation of the trachea and commencement of the lungs,

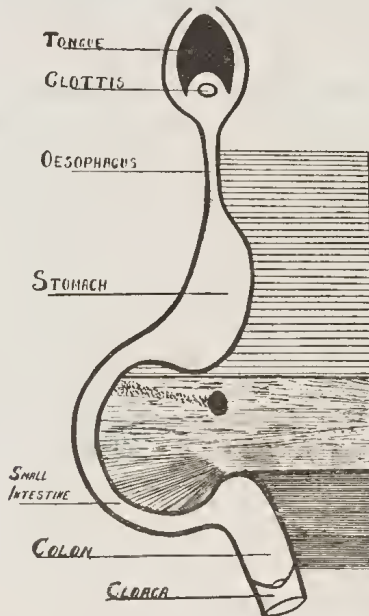


FIG. 1.—Diagram to represent gastro-intestine in skink, stump-tailed lizard, and monitor. The fold connecting the parts to the dorsal wall can be divided into 3 divisions. These from above down are mesogaster, mesentery, and mesocolon. In the mesentery are seen the pancreas and the spleen.

which latter are traced dorsal to the liver and stomach, liver and gall bladder, stomach, small and large intestine or colon, and dorsal to the latter are the ovaries and oviducts in the female, and in the

male the testes and sperm ducts. Most caudal lie the kidneys, one on each side, dorsal to the cloaca.

*Mouth and Pharynx.*—An examination of the mouth of lizards shows three important differences as compared with mammals.

(1) The laryngeal opening or glottis, lying at the base of the tongue, which is forked for its reception, is not provided with an epiglottis. What may be its precursor is seen in a fold lying in front of the glottis extending from one lingual prong to that of the other. (2) The mouth is not only a conduit for food, but for air as well. At first glance it looks as if the nasal passage were separated from the oral, as the glottis appears to fit into a depression in the palate, but the latter is seen to be incomplete, though this is not so marked e.g. in the stump-tailed lizard as in the giant skink. (3) Though minute mucous-secreting labial and lingual glands are present, we are struck by the absence of defined salivary glands as seen in even such a lowly mammal as the echidna. From this it would appear that true salivary or serous secretion is a characteristic of mammalian life. These factors in connection with the mouth are of first rate importance not only to the physiologist, but to the surgeon also.

The mouth is succeeded by a gradually narrowing pharynx whose length and greatest width is about 3 cm. Its interior is somewhat rugous owing to the presence of fine longitudinal bands.

*Oesophagus.*—The gullet is a narrow tube-like structure, measuring about 5 cm. in length with a greatest width of .5 cm. Its interior, like that of the pharynx, is roughened, owing to the presence of longitudinal folds. There is a well defined sphincter or lock at the junction of the oesophagus and stomach, although we have dissected a stump tailed lizard in which the transition was scarcely evident.

*Stomach.*—This is a well-defined organ obliquely placed in the general cavity, with its proximal half lying dorsal to the liver, but ventral to the left lung. It gradually narrows towards the pyloric extremity. The pyloric or distal extremity is on a plane ventral to the cardiac or proximal extremity. When moderately distended it is seen to be rugous, which is especially marked towards the pyloric extremity where the longitudinal rugae end abruptly at the pyloric sphincter or lock, which forms a sharp definition between the stomach and the small intestine. The length of the stomach is about 8.5 cm., and the breadth, when moderately distended, is 2.5 to 3 cms. The breadth of the double suspensory fold, or mesogaster, connecting the stomach to the dorsal wall may reach 5 cm.

*Small Intestine.*—There is no microscopic differentiation of a duodenum, such as we see in mammalia, to be met with in the stump-tailed lizard or skinks. The functional impetus that has necessitated its appearance in the latter has not arisen in these nor in the snakes or monitors. In lizards, such as the bearded and the frilled, that have developed a caecum, a duodenal loop is present, and in these reptiles it is 3 cm. long with greatest width of mesoduodenum.

2.75 cm., and of mesentery 6 cm. As in monotremes duodenal glands are not found. The total length of small intestine varies from 12 to 22 cms. It is looped, freely moveable, being swung from the dorsal wall by a suspensory fold or mesentery, whose greatest width may equal 7 cm. In the proximal portion of this fold are seen the diffuse pancreatic organ and the spleen.

*Colon or Large Intestine.*—The small gut is succeeded abruptly by the colon, from which it is separated, as in man, by a well developed colic sphincter or lock. The colon runs without convolution along the dorsal wall, to which it is related by gradually narrowing suspensory fold or mesocolon, the greatest width at the commencement of which may equal 2 cm. The colon measures 7-9 cm. long and terminates like the bladder, renal, and genital systems, in a terminal compartment or cloaca. Its cloacal opening is extremely minute, easily missed, and is provided with a well defined sphincter.

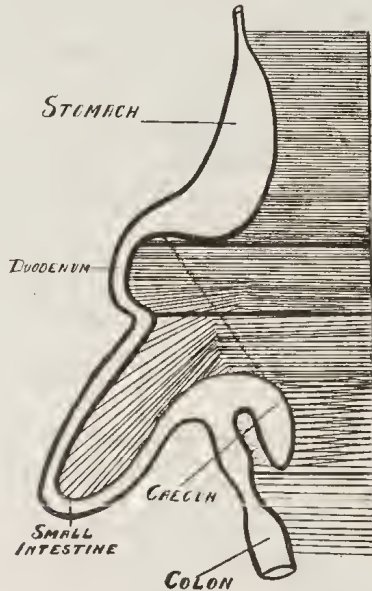


FIG. 2.—Diagram of gastro-intestine in frilled and bearded lizards. The fold connecting the parts to the dorsal wall can be divided into 4 divisions. These beginning from above down are mesogaster, mesoduodenum, mesentery, and mesocolon. The mesoduodenum and mesentery are crossed by the mesial or suspensory fold.

Ventral to the colon lies the bladder, and on either side of the mesocolon lies, in the female, the ovaries and oviducts, and in the male, the testes and sperm ducts. When distended the width of this gut may equal 3 cm. A small unilateral dilatation representing caecal formation is occasionally seen at the commencement of the colon in the giant skink. We have never seen any attempt at caecal formation in the stump-tailed lizard. From the point of view of caecal study,





Junction of small and large intestine in bearded lizard and blue-tongued skink. In the former we see the development of a well defined curved blind gut or caecum.



however, an examination of the frilled and of the bearded, or jew, lizard is of prime importance.

These two reptiles are characterized by the presence of a definite curved blind gut, or caecum, somewhat resembling that seen in *Perameiidae*. Its length is about 4 cm., and at its commencement the greatest width is 1 cm., but at its termination less than .5 cm. Its distal, or blind, end is curved towards the colon to which it is connected by a fine mesentery. Serving to connect this portion of the intestine with the pyloric region, is a fold stretching across the mesentery representing the genesis of the mesial or suspensory fold, which is well demonstrated in *Koala*. It is not present in monitor, giant skink, or stump-tailed lizard—animals not provided with a caecum. The fold is 2.5 cm. long, whilst the interval between colon commencement and stomach in the giant skink may equal 6 cm.

When in a bearded lizard, the distance was about 9 cm. from ilio-colic junction to vent, (without including caecal measurement), it was found that the proximal portion of the colon 3 cm. long and width 1.5 cm., was separated from the distal 5 cm. with a width of 1 cm., by a narrow sphincteric portion about .75 cm. long and width of less than .5 cm. The sphincteric portion and the distal 5 cm.

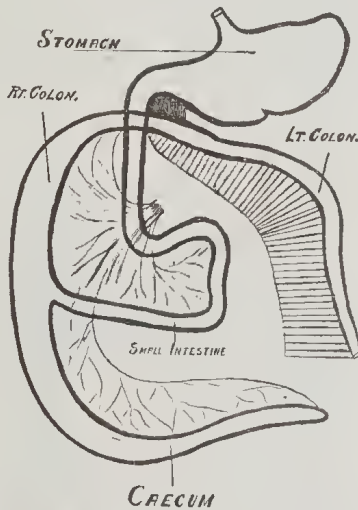


FIG. 3.—Diagram of gastro-intestine in the Australian *Koala*. The left colon is swung freely on the mesocolon, and the right colon with the small intestine on the mesentery. The colon is suspended at the pyloric region of the stomach by the mesial fold.

were swung on the mesocolon, the proximal portion, with caecum, being swung with small gut on the mesentery, this representing the genesis of the mesenteric colon, which can be best studied in *Koala* and man. In the frilled lizard it was found that the development

of mesenteric colon and caecum, and their approximation of the pylorus, were even more decided than in the bearded lizard.

*Cloaca.*—This terminal canal is about 1.5 cm. long, and its transverse outlet, or anus, which has a scaly covering, is guarded by a well defined sphincter. The allantoric bladder lies in front of the termination of the colon, the wall of which is thinner than in the more proximal portion. The bladder opening is ventral to that of the colon. There is a fold separating the colic orifice from the renal and genital openings on each side which lie more dorsally. The penes in the male are connected with the cloaca just within the sphincter.

We have seen in the stump-tailed lizard the termination of the colon converted into a compartment 1.5 cm. long, each extremity of which was guarded by a sphincter, one colic the other cloacal.

(b) *Monitors.*

Apart from an increased bulk in an animal measuring 50 cm. from snout to vent, the gastro-intestinal tract resembles in its simplicity, that of the stump-tailed lizard and the giant skink. The stomach may reach 20 cm. in length, and is capable of great distention; and even after a moderate feeding, the breadth may equal 8 cm. The small gut reaches 38 cm. long and the colon 17 cm. In one specimen measuring 48 cm. from snout to vent, the length of small gut was 14 cm., and colon 12 cm. The colon, like the stomach, is capable of great distension, and, when moderately enlarged, its

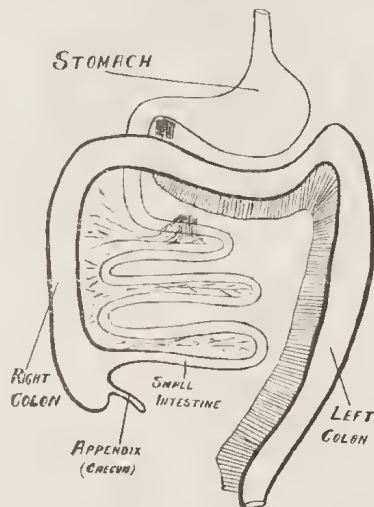


FIG. 4.—Diagram to illustrate the human gastro-intestinal tract. Owing to dorsal fixation in response to the erect posture, only the small intestine and lower portion of the right colon are swung on the mesentery. The mesentery of the greater portion of the right colon, and the mesocolon of the left colon are not now demonstrable as in Koala, although shown in the diagram.



breadth may equal 3 cm. There is no caecum, and no mesial suspensory fold, such as we find in the bearded lizard. The cloacal arrangement is similar to that above described.

(c) *Snakes. (Ophidia).*

In the Australian snakes, both poisonous and non-poisonous, from the point of view of peritoneal relationship and functional differentiation, we are dealing, as in the case of lizards, with a simple condition of gastro-intestine. There is no development of great omentum, caecum, or mesenteric colon, neither is there differentiation of a duodenum, although, in the carpet snake, a diverticu-

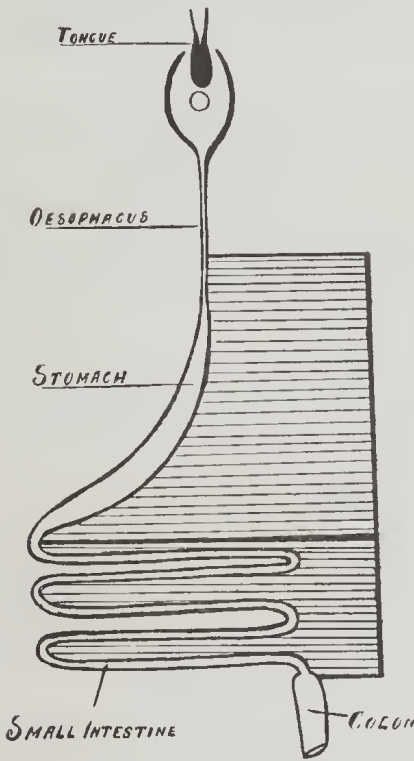


FIG. 5.—Diagram to illustrate the gastro-intestine of Australian snakes.

lum resembling, as regards size and shape the appendix of the echidna, is met with. Compared with that of the lizard, the gastro-intestine gives the idea of elongation, of having been drawn out to accommodate itself to body contour. The tongue is narrow, forked at the extremity, and obtrudes from, or retracts within, a sac on the floor of the mouth, the opening of which is immediately in front of the glottis. The tongue is often confused in the lay mind with the fangs. The pharynx measures 2-3 cm. with a greatest width of 2 cm. The oesophagus is long measuring on an average 36 cm. with a width of 5 cm. The stomach is a curved rounded elongate body